REMARKS

Claims 1-21, 23, 25-32, 34, 36-38, 40, 43-48, 50, 52-63 and 65-68 are pending in the present Application. Claims 22, 24, 33, 35, 39, 41, 42, 49, 51 and 64 were previously cancelled. Claims 1-15, 32, 53-62, and 65-68 are withdrawn from consideration. Claims 16-21, 23, 25-31, 34, 36-38, 40, 43-48, 50, 52 and 63 are under active consideration. No claims are currently amended.

The Office rejected claims 25 and 63 under 35 U.S.C. § 112, first paragraph. In addition, the Office rejected claims 16-21, 23, 26-31, 34, 36-38, 40, 43-48, 50 and 52 under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a) over Padture et al. (Acta Mater. 49 (2001) 2251-2257 – article "Towards Durable Thermal Barrier Coatings with Novel Microstructures Deposited by Solution Precusor Plasma Spray).

Rejection Under 35 U.S.C. § 112, First Paragraph

The claimed materials (claims 26 and 63) possess physical features that can include splats, the presence and/or absence of inter pass boundaries and the presence and/or absence of vertical cracks. These features are formed in the material by varying a number of parameters during the manufacture of the material.

In general, the material is formed by coating a substrate with multiple layers using precursor solution injected into a thermal spray flame. Parameters that are utilized to form the material include:

1) injecting precursor solution such that a portion of the precursor solution droplets enters the hot zone of the flame

2) injecting precursor solution such that a portion of the precursor solution droplets enters the cool zone of the flame

3) fragmenting droplets to form reduced size droplets

4) pyrolizing the reduced size droplets to form pyrolized particles in the hot zone

5) partially melting the pyrolized particles in the hot zone

6) depositing the partially melted pyrolized particles on a substrate

7) fragmenting a portion of the precursor solution to form smaller droplets

8) forming non-liquid material from the smaller droplets in the cool zone of the flame and

9) depositing the non-liquid material on the substrate (see paragraph [0005]).

As Applicants note in paragraph [0024], other parameters that may be varied to achieve the desired coating structure include precursor solution viscosity, precursor solution surface tension, precursor solution concentration, droplet momentum, injection location, flame temperature and droplet residence time in the cool and hot flame zones. These parameters are used to form the claimed splat, inter pass boundary and crack features.

Yet other parameters that are varied to obtain the claimed material include:

10) heating the substrate prior to thermal spraying and/or maintaining the substrate temperature within a given range (paragraph [0025])

11) precursor solution solvent type (paragraph [0030])

12) spraying precursor solutions simultaneously or sequentially (paragraph [0030])

13) injector nozzle orientation and angle relative to the flame axis (paragraph [0032])

14) argon flow rate which impacts flame temperature (paragraph [0034]) and

15) varying the horizontal and vertical traverse speed and spray distance of the gun (table 2).

Applicants submit that these disclosed listings of parameters provide one skilled in the art with sufficient information to produce a coating with the claimed features. Applicants submit these disclosure parameters are sufficiently finite that one skilled in the art could generate the claimed materials without undue experimentation. Applicants submit that one skilled in the art (a worker familiar with thermal spraying techniques) is capable of manipulating these parameters to readily obtain the claimed features.

Applicants have also specifically described that injecting the precursor solution droplets predominately into the hot zone of the flame results in a material having an average splat size less than or equal to about 2 micrometers (paragraph [0023]). Applicants have noted that argon flow rate (and thus temperature) may be used to control the number of vertical cracks and porosity (paragraph [0034]). In addition, Applicants recites that non-liquid material formed in the cool zone of the flame also contributes to porosity, vertical cracks and inter pass boundaries.

Finally, Applicants direct the Office to the examples in the specification and table 2 where some of the parameters and methods used to generate the claimed features are given.

With regard to the Office's comments on pages 2 and 3 of the Office Action, Applicants submit that the disclosure provides guidance as to how to generate inter pass and no inter pass boundary regions. Applicants submit that these regions are formed during the coating process <u>by varying the parameters as discussed above</u>. In particular, adding the precursor solution predominately to the hot zone gives splats with no inter pass boundary region (paragraph [0023]). Controlling the amounts of precursor solution going into the hot and cool zones from the injector control, in part, the amounts of porosity, vertical cracks and inter pass boundaries. In addition, for example, varying the horizontal and vertical traverse speed and spray distance of the gun has an impact on the formation of inter pass boundaries.

The Office states that "typical flame spraying devices include a hot and cool zone and the cool zone is believed to contribute to forming non-liquid material for an inter pass

boundary, it is the position of the Examiner that the precursor material which contacts the cool zone during the plasma spray deposition would inevitably form a resultant inter pass boundary." Applicants respectfully disagree. Having precursor solution go through the cool zone, by itself, is not sufficient to form an inter pass boundary. Other parameters like horizontal and vertical traverse speed and spray distance of the gun can control the formation of inter pass boundaries. In addition, the Office assumes that precursor solution must necessarily go only through the cool zone.

As discussed above, the relative amount of precursor solution entering the hot and cool zones, in part, controls the formation of an inter pass boundary. In general, the plasma has a central hot core surrounded by a cooler periphery. When the droplets are injected normal to the plasma, there are at least 2 possibilities: (1) with lower momentum, the droplets will be carried on the periphery of the plasma (cool zone) and will arrive as unpyrolized or semi-pyrolized material, and (2) with higher momentum, the droplets will penetrate and be retained in the plasma core (hot zone) and deposited as ultra-fine splats. If the droplets are injected with higher momentum, little or no precursor solution will enter the cool zone.

As the precursor material proceeds in the axial direction through the flame, material that enters the hot zone will eventually pass through a cooler zone as the Office has suggested. However, having passed through the hot zone first the material is irreversibly pyrolized and this material will create ultra-fine splats <u>not</u> interpass boundaries. Therefore, the Office's conclusion that "the precursor material which contacts the cool zone during the plasma spray deposition would inevitably form a resultant inter pass boundary" is incorrect since this is not a necessary result.

Based on the discussion above, Applicants submit that the application satisfies the requirements under 35 U.S.C. § 112, first paragraph. Therefore, Applicants respectfully request that the Office withdraw the rejection of claims 25 and 63 under 35 U.S.C. § 112, first paragraph.

Rejection Under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a)

As discussed above, the claimed material with the claimed physical features is manufactured by varying a number of parameters in order to achieve the different physical features with the coating layers. Applicants submit that these techniques, and in turn these physical features, are not taught or suggested by Padture. Indeed, Applicants submit that Padture teaches away from the claimed material, and therefore, the claimed material would not have been anticipated or obvious under Padture.

Padture describes a method for producing thermal barrier coatings by solution precursor plasma spray (abstract). As described in the experimental procedure section of Padture (p. 2252),

> "all coatings reported here were deposited under nominally <u>identical</u> experimental condition …"

In Padture all the layers are identical. In contrast, the claimed material with splats and inter pass boundary regions was generated by <u>varying</u> experimental conditions so that <u>different</u> layers are formed as discussed above.

Specifically, as noted above, these different layers are formed, in part, by injecting precursor solution into hot and cold zones within the plasma flame at different ratios. It is not clear from Padture where the precursor solution was injected but it is clear that the precursor solution was injected <u>into the flame in the same manner each time</u>. Consequently, Padture can not form different types of layers but can only form one type of layer. Accordingly, Padture teaches away from the use of variable parameters as discussed above and away from different physical features as claimed within the layers of the material.

The Office concludes that Padture teaches or suggests both splats and inter pass regions. Applicants submit that this is not possible with the procedure described in Padture. As noted above, the various physical features of the material, like the inter pass boundary, are formed by varying the parameters as discussed above. Such parameters may include, for example, the relative amounts of precursor solution entering the hot and cool zones and the operation of the gun with parameters like gun speed and distance. Hence the conclusion that Padture would necessarily form various features like an inter pass zone boundary is incorrect.

Because Padture teaches identical experimental conditions during the coating process, Padture necessarily forms only one type of coating layer. Therefore, Padture does not teach or suggest the claimed structure with different layers within the claimed material, and accordingly, the claimed material would not have been anticipated or obvious over Padture. As such, Applicants respectfully request that the Office withdraw the rejection of claims 16-21, 23, 16-31, 34, 36-38, 40, 43-48, 50 and 52 under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a) over Padture.

It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance are requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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